WHAT IS CLAIMED IS:

1. A method comprising contacting at least an alkane having from 2 to 4 carbon atoms to a catalyst comprising at least nickel oxide and dehydrogenating said alkane with a selectivity of greater than 70% and a conversion of greater than 10%.

2. The method of claim 1 wherein said selectivity is greater than 75%.

3. The method of claim 2 wherein said selectivity is greater than 80%.

4. The method of claim 3 wherein said selectivity is greater than 85%.

5. The method of claim 1 wherein said conversion is greater that 15%.

6. A process for the oxidative dehydrogenation of an alkane having from 2 to 4 carbon atoms comprising contacting said alkane in the presence of oxygen to a compound comprising nickel oxide and obtaining a selectivity in said dehydrogenation of greater than 70% and a conversion of greater than 10%.

7. The method of claim 6 wherein said selectivity is greater than 75%.

8. The method of claim 7 wherein said selectivity is greater than 80%.

9. The method of claim 8 wherein said selectivity is greater than 85%.

10. The method of claim 6 wherein said conversion is greater that 15%.

11. A process for the oxidative dehydrogenation of an alkane having from 2 to 4 carbon atoms comprising

contacting a gas mixture comprising said alkane and oxygen to a nickel oxide containing catalyst; and

obtaining a selectivity greater than 70% and a conversion greater 10%.

12. The method of claim 11 wherein said selectivity is greater than 75%.

13. The method of claim 12 wherein said selectivity is greater than 80%.

14. The method of claim 13 wherein said selectivity is greater than 85%.

15. The method of claim 11 wherein said conversion is greater that 15%.

16. A method for the oxidative dehydrogenation of an alkane having from 2 to 4 carbon atoms comprising contacting said alkane in the presence of oxygen to a material having the empirical formula

$Ni_xNb_yTa_zO_i$

wherein x is in the range of about 0.05-0.96, y is in the range of from about 0-0.8, z is in the range of from 0-0.8 and i is a number that satisfies valence requirements; and the sum of y and z is at least 0.1.

17. The method of claim 16, wherein x is in the range of from about 0.4 to 0.96.

18. The method of claim 16 wherein x is greater than 0.5.

19. The method of claim 16 wherein y and z are each greater than zero and wherein the sum of y and z is smaller than 0.6.

20. A method for the oxidative dehydrogenation of an alkane having from 2 to 4 carbon atoms comprising contacting said alkane in the presence of oxygen to a material having the empirical formula

$Ni_xA_jB_kC_lO_i$

wherein Ni is nickel and x is in the range of about 0.05-0.96;

A is a metal selected from the group consisting of Co, Nb, Ta and combinations thereof and j is in the range of from about 0-0.8;

B is a dopant selected from the group consisting of Li, Na, K, Rb, Cs, Mg, Ca, Sr, Ba, Mn, La, Ce, Pr, Nd, Sm and combinations thereof and k is in the range of from 0-0.5;

C is a dopant selected from the group consisting of Sn, Al, Fe, Si, B, Sb, Tl, In, Ge, Cr, Pb and combinations thereof and l is in the range of from 0-0.5

i is a number that satisfies the valence requirements of the other elements present; and the sum of j, k and l is at least 0.1.

21. The method of claim 20, wherein x is in the range of from about 0.5 to 0.85.

22. The method of claim 20 wherein x is greater than 0.1.

23. The method of claim 20 wherein j, k and l are each greater than zero and wherein the sum of j, k and l is smaller than 0.8.

24. A method of making a C_2-C_4 olefin comprising the step of contacting a gas mixture with a catalyst having an empirical formula:

$$Ni_aCo_bNb_cTa_dSn_eK_fAl_gFe_hO_i;$$

wherein *b*, *c* and *d* are numbers greater than or equal to zero, but less than one, and at least one of *b*, *c* and *d* is nonzero;

e and *f* are numbers greater than or equal to zero, but less than or equal to 0.35;

g and *h* are numbers greater than or equal to zero, but less than or equal to 0.10;

a is a number greater than zero, but less than one, and satisfies:

$$a \leq 1 - b - c - d - e - f - g - h;$$

i is a number that satisfies valence requirements; and

the gas mixture comprises a C_2-C_4 alkane and oxygen.

25. The method of claim 24, wherein:

c is greater than or equal to 0.10, but less than or equal to 0.85; and

b, *d*, *e*, *f*, *g*, and *h* equal zero.

26. The method of claim 25, wherein *c* is greater than or equal to 0.12, but less than or equal to 0.42.

27. The method of claim 26, wherein *c* is greater than or equal to 0.14, but less than or equal to 0.25.

28. The method of claim 25, wherein *c* is greater than or equal to 0.20, but less than or equal to 0.50.

29. The method of claim 28, wherein *c* is greater than or equal to 0.31, but less than or equal to 0.41.

30. The method of claim 24, wherein:

d is greater than or equal to 0.10, but less than or equal to 0.60; and

b, *c*, *e*, *f*, *g*, and *h* equal zero.

31. The method of claim 30, wherein *d* is greater than or equal to 0.19, but less than or equal to 0.50.

32. The method of claim 30, wherein *d* is greater than or equal to 0.14, but less than or equal to 0.25.

33. The method of claim 24, wherein:

b is greater than or equal to 0, but less than or equal to 0.20;

c is greater than or equal to 0, but less than or equal to 0.80; and

d, *e*, *f*, *g* and *h* equal zero.

34. The method of claim 33, wherein *b* is greater than or equal to 0.001, but less than or equal to 0.20; and *c* is greater than or equal to 0.02, but less than or equal to 0.56.

35. The method of claim 33, wherein *b* is greater than or equal to 0, but less than or equal to 0.30; and *c* is greater than or equal to 0, but less than or equal to 0.45.

36. The method of claim 35, wherein *a* is greater than or equal to 0.55, but less than or equal to 0.85.

37. The method of claim 33, wherein:

b is greater than or equal to 0, but less than or equal to 0.33; and

c is greater than or equal to 0, but less than or equal to 0.52.

38. The method of claim 37, wherein:

b is less than or equal to 0.10; and

c is greater than or equal to 0.20, but less than or equal to 0.50.

39. The method of claim 37, wherein:

b is less than or equal to 0.03; and

c is less than or equal to 0.50.

40. The method of claim 39, wherein *c* is greater than or equal to 0.15, but less than or equal to 0.26.

41. The method of claim 37, wherein:

b is greater than or equal to 0.001, but less than or equal to 0.19; and

c is greater than or equal to 0.13, but less than or equal to 0.33.

42. The method of claim 41, wherein *c* is less than or equal to 0.23.

43. The method of claim 24, wherein:

c is greater than or equal to 0, but less than or equal to 0.50;

d is greater than or equal to 0, but less than or equal to 0.50; and

b, *e*, *f*, *g* and *h* equal zero.

44. The method of claim 43, wherein:

c is greater than or equal to 0.03, but less than or equal to 0.40; and

d is greater than or equal to 0.02, but less than or equal to 0.29.

45. The method of claim 43, wherein:

a is greater than or equal to 0.46, but less than or equal to 0.96;

c is greater than or equal to 0.04, but less than or equal to 0.44; and

d is greater than or equal to 0.04, but less than or equal to 0.44.

46. The method of claim 45, wherein:

a is greater than or equal to 0.54, but less than or equal to 0.72;

c is greater than or equal to 0.04, but less than or equal to 0.38; and

d is greater than or equal to 0.04, but less than or equal to 0.40.

47. The method of claim 46, wherein:

a is less than or equal to 0.65;

c is less than or equal to 0.20; and

d is greater than or equal to 0.15.

48. The method of claim 24, wherein:

c, *d* and *e* are each greater than or equal to 0, but less than or equal to 0.35; and

b, *f*, *g* and *h* equal zero.

49. The method of claim 24, wherein:

c, *d* and *f* are each greater than or equal to 0, but less than or equal to 0.35; and

b, *e*, *g* and *h* equal zero.

50. The method of claim 46, wherein:

a is greater than or equal to 0.58, but less than or equal to 0.64;

c is greater than or equal to 0.06, but less than or equal to 0.38;

d is greater than or equal to 0.04, but less than or equal to 0.30; and

f is less than or equal to 0.26.

51. The method of claim 47, wherein:

a is greater than or equal to 0.55, but less than or equal to 0.65;

c is greater than or equal to 0.30, but less than or equal to 0.40; and

b, *d*, *e*, and *f* equal zero.

52. The method of claim 51, wherein:

a is greater than or equal to 0.58, but less than or equal to 0.61;

c is greater than or equal to 0.35, but less than or equal to 0.36;

g is greater than or equal to 0, but less than or equal to 0.05; and

h is greater than or equal to 0, but less than or equal to 0.07.

53. The method of claim 24, wherein the gas mixture further comprises a material selected from the group consisting of ethylene, butylenes or raffinate II.

54. The method of claim 24, wherein said contacting is carried out at a temperature of about 400°C or less.

55. The method of claim 24, wherein the contacting step is carried out at a temperature of about 325°C or less.

56. The method of claim 24, wherein the contacting step is carried out at a temperature of about 300°C or less.

57. The method of claim 24, wherein said catalyst is not supported on a carrier.

58. The method of claim 24, wherein said catalyst is supported on a carrier selected from the group consisting of silica, alumina, titania, zirconia, magnesia, zeolites, clays and combinations thereof.

59. The method of claim 24 wherein said contacting is carried out for a time in the range of from about 100 milliseconds to about 10 seconds.

60. The method of claim 24, wherein said gas mixture comprises oxygen in the range of from about 0.01-20% by volume and ethane in the range of from about 10-99.99% by volume.

61. The method of claim 60, wherein said gas mixture further comprises diluents in the range of from about 0.01-60% by volume.

62. The method of claim 60, wherein said reaction pressure is in the range of from 0.5 to 20 bar.

63. The method of claim 24, wherein said catalyst is diluted with a binder or inert filler.

64. The method of claim 24 wherein said catalyst is calcined at a temperature of 400°C or less.

65. The method of claim 24 wherein said catalyst is calcined at a temperature of 350°C or less.

66. The method of claim 24 wherein said catalyst is calcined at a temperature of 300°C or less.

67. A method for the oxidative dehydrogenation of ethane to ethylene, optionally with ethylene as a co-feed with said ethane, comprising contacting ethane to a catalyst comprising nickel oxide (NiO) with either niobium oxide (Nb_2O_5) or tantalum oxide (Ta_2O_5).